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THE INFLUENCE OF GEOGRAPHIC ENVIRONMENT.

Perhaps there is no one thing which affects a primitive people to so great a degree as the character of their geographic environment; that is to say, the topographic character of their country and its climate. This has been shown repeatedly in the history of the world, but never more clearly than in the case of our Pueblo Indians, who have been located since their discovery in 1539 and conquest in 1540 by the old Spanish conquistadores in what is now New Mexico and Arizona.

Inherited ideas, habits and customs, mythology, and social systems, all affect a people, but they act through and upon the physical environment, and are eventually modified by it. So the stone-built houses of the Pueblos, in themselves the picture of unchanged adherence to an inherited type, are, in point of fact, the direct product of the country where they are found, and reflect its peculiarities. The systematic study of the southwestern ruins pursued by the Bureau of American Ethnology for fifteen years, the results of which are now becoming available, has demonstrated clearly the close accord which existed, and still exists, between the pronounced topography of the mesa country, or the plateau country, as it has been termed, and the highest type of art in architecture attained by the aborigines within the limits of what is now the United States.

The ancient Pueblo culture was so intimately connected with and dependent upon the country where its remains are found, that is, the plateau province, that a map of the latter, slightly extended around the margins and a little more to the south, would serve to show the former. The area of the pueblo country is about 150,000 square miles; that of the plateau country about 130,000. On the north it reaches to Great Salt Lake, on the south it extends over

the Gila River and beyond the limits of our country. On the west the Grand Canyon of the Colorado bounds the region, while on the east it extends a little beyond the Rio Grande and the Pecos.

The plateau region is not, as its name might imply, a smooth and level country; on the contrary, it is extremely rugged and broken, and travel is more difficult than in many mountain districts. It is a land of cliffs and canyons, often of great magnitude and always abundant, forming serious obstacles to wagon travel in any direction. The whole surface, apparently smooth and level, is composed of platforms or mesas. There are mesas everywhere; it is the mesa country. The flat tops of the plateaus are cut and seamed by gorges and narrow canyons, often impassable to a horse. Except along a few routes which have been established here and there wagon travel is difficult, and not infrequently the explorer is compelled to send his wagons fifty or sixty miles around to reach some point not twenty miles distant.

To the traveller in the valley the country appears to consist of sandy plains, bounded in the distance by rocky cliffs. From the summits of the higher plateaus he looks over a landscape of undulating surface broken by low wooded hills. But from the mountain tops he looks down upon a land everywhere cut into a network of jagged canyons—a confused tangle of cliffs and gorges without system.

The topographic features of the region are due to its geological peculiarities. It is doubtful whether anywhere could be found single formations which preserve their characteristics over such immense areas as here; and this, together with the apparently horizontal position of the strata, gives a peculiar monotony to the landscape, a sameness which appears to extend for hundreds of miles. But although the strata appear to be horizontal, they are, in fact, slightly tilted. The inclination, although slight, is persistent, and the thickness of the strata remains remarkably constant. Hence it comes about that the beds extend from high altitudes to comparatively low ones. Each formation appears as a terrace, bounded on one side by a descending cliff, carved out of the edges of its own strata, and on the other by an ascending cliff formed of the edges of the strata which overlie it. This is the usual form; but isolated mesas—bits of table-land completely engirdled by cliffs and standing up out of the valley like huge single rocks—are but little less common. The courses of the margins of the mesas are very irregular. The cliffs sometimes maintain an average trend through many miles, but in detail their

courses are extremely crooked; they wind in and out, forming alternate alcoves and promontories in the wall, and frequently they are cut through by valleys, which may be either narrow canyons or interspaces ten or even twenty miles wide.

The whole region has been subjected to great displacements, both folds and faults. Some of the flexures attain a length of over 80 miles and a displacement of 3,000 feet, and the faults are of even greater magnitude. There is also abundant evidence of great volcanic activity in the past, and although the principal eruptions have occurred about the borders of the province, traces of lesser disturbances can be seen everywhere throughout it. The oldest eruptions do not go back of Tertiary time, while the most recent are said to have occurred within the historic period—that is, less than four centuries ago.

The plateaus are cut here and there by high ranges of mountains, which afford some relief to the eye of the traveller wearied by the eternal monotony of the plains. These high mountain districts are characterized by a growth of giant pines, with firs and spruce in the highest parts and many little groves of scrub oak. The comparatively regular spacing of the great pines, and the entire absence of underbrush, give a certain park-like aspect to these regions. Going downward the pines merge into pinyons,\* useful for firewood, but almost valueless as timber, and these in turn give place to junipers and cedars, which are found everywhere throughout the foothills and on the high mesa lands.

But the prevailing aspect is that of a timberless region. Miles upon miles of the flat country, the valleys and great plains, and the low mesas which bound them, are entirely destitute of trees. The monotony of the landscape is aided rather than diminished by the vegetation, for this, like the human occupants of the country, has come under its overmastering influence. The vegetation of the valley regions consists only of sage brush and grease-wood, with a scanty growth of grass in favorable spots, and the characteristic view is a wide expanse of featureless plains bounded by far-off cliffs in gorgeous colors; in the foreground a soil of bright yellow or pearly grey; over all the most brilliant sunlight, while the distant features are softened by a blue haze.

For a few weeks in early summer the table-lands are seen in their most attractive guise. The open summits of the mesas are clothed with a carpet of verdure almost hidden under a profusion of flowers. The grey and dusty sage takes on a tinge of green,

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\* *Piñon*, nut pine.

and even the repulsive greasewood conceals its spines beneath a cloud of golden blossoms. Cacti of various kinds vie with each other in producing the most brilliant flowers, odorless but gorgeous. But soon all this brightness fades and the country resumes its dreary aspect.

The rainy season comprises most of July and August, and sometimes part of September. During this period sudden heavy showers of short duration are frequent, and the thirsty soil absorbs a considerable share of moisture; but most of the water very quickly finds its way into deep-cut channels, and then, in heavy torrents, it is carried to the great canyons of the Colorado and its tributaries. The region, therefore, is not so well favored in the matter of water as even its small annual precipitation would imply, for, coming as it does all at once, more than half of the water is carried off directly from the surface of the ground and does not percolate through it.

The direct dependence of the savage on nature as he finds it is nowhere better illustrated than in this region. In the three essentials of land, water, and vegetation, the country is not an ideal one, but it is blessed with an ideal climate. In these dry elevated regions the heat is never oppressive, even when the thermometer reads 125 or 130 degrees, and the nights are always cool. The day readings of the thermometer are almost incredible, but there is no discomfort from such high temperatures for the reason that the very slight humidity of the air renders them hardly perceptible. The range between the day and night temperatures is often very great, but the houses of the Pueblo Indians have been conformed to these as well as other local conditions, and they are cool in hot weather and warm in cool weather.

The extent to which the physical peculiarities of the country have dominated the habits and customs of the people, their arts, and even their mythology, shows that this peculiar culture is a local product; that it was developed either in the region where it was found, or in one very similar to it. The whole system of mythology, while elaborate and complex, revolves around one central idea—the want of water. The Pueblo Indians are essentially farmers, and studies of ancient ruins show that in former times the products of the soil formed even a greater share of their means of subsistence than they do now.

Farming operations are always conducted on a very small scale—it is not agriculture but horticulture, gardening rather than field culture. Little nooks and sheltered corners in the mesas or small

patches in the valleys are cultivated to the highest degree, but by peculiar methods. In former times the staple was corn or maize, which to-day forms the main subsistence of these Indians, and in the northern and western part of the province where large areas of cultivable land were not available, the seed was usually planted in the sandy beds of intermittent streams, whose underflow served to keep the sand moist enough to mature the crop, for the seed was often planted a foot deep or more. In the large river valleys of the central and eastern part of the pueblo country irrigation is now extensively practiced, as it was in ancient times in the south, and the size of the crops is materially increased. But it is a mistake to suppose that irrigation was universally employed, or even that it was as much used in ancient times as now. Over the greater part of the region crops can be raised, and are raised to-day, without the artificial application of water, although with irrigation the chances of successfully growing a crop are much better than without it.

The custom of cultivating small patches here and there rather than large fields in one place was dictated by the character of the country and acted in turn on the houses and villages of the people. Over most of the region arable lands are found only in small areas, and the cultivation of these necessitated the partial breaking up of large communal villages. That is, while the large village remained the home of the people who had their houses there, they left it in the summer months to live in other places more convenient to their field of labor. These places were often 10 or 15 miles or even more from the home village, as in the summer villages of Ojo Caliente, Nutria, and Pescado, attached to the Pueblo of Zuñi.

As a rule, however, the summer settlements were not grouped into villages, for the little patches of cultivable land are usually few and far between, but consist of one or two rooms only. When the harvest is gathered these are abandoned for a time, the inhabitants retiring for the winter to the home village. From this custom it has resulted that practically all the religious ceremonies and dances take place at the home village in the fall and winter season and the early spring, when the people are congregated there. As a consequence the kivas, or sacred ceremonial chambers, in which many of the rites are prepared or take place, are found only in the home villages; and it is often possible to distinguish among the ruins the home pueblo from the subordinate summer settlements by the presence or absence of the kivas.

It seems odd at first sight and until we realize how completely the savage is a child of nature, that the whole life of a people should be

affected and dictated as it were by the minute topographic peculiarities of the country in which they live, but the effect of these peculiarities goes even farther, and it is to them that we must attribute the enormous number of ruins scattered over the southwest. The number of these remains has puzzled all students of the subject, and many writers have been driven to assume a large population; but that idea has now been pretty well abandoned.

The solution of the problem will be found in the peculiar custom just described; in other words, in the topographic peculiarities of the country. Many lines of evidence, tradition, arts, customs, mythology, and the ruins themselves, all concur in establishing the fact that the pueblo tribes were in slow but constant movement. Viewed across long periods of time it may be regarded as a migration, but it was not like the European migrations. The movement was extremely slow; a band might occupy one place for 20, 50, or even 100 years, and then locate at another, perhaps for an equal period, perhaps only for a year or two. The early students of the southwest were disposed to read in the ruins the evidence of an enormous population, and estimates of 150,000 or even 250,000 souls were not uncommon, but it is now fairly well established that the population of the pueblo country, now about 10,000, never exceeded 30,000 people, if indeed it reached that number. At first sight it seems unlikely that this comparatively small number of people could have left the thousands of ruins which dot the mesas and valleys of Arizona and New Mexico, but when we understand the peculiarities of the country and the sensitiveness of a primitive culture to such peculiarities the matter becomes clear.

The typical mesa is an elevated flat-topped eminence, sometimes standing alone, sometimes extending out from higher ground. The term mesa, which is from the Spanish and means table, is very descriptive and expressive. The edges of the mesas break down in cliffs or very sharp slopes, exposing the edges of the strata of which they are composed. The prevailing formations throughout this region are sandstones of light yellow and bright red; some of them are very soft, others are quite hard, while nearly all of them appear to be well stratified or laminated. The alternation of hard and soft strata in a cliff wall causes an alternation of vertical cliffs and steep slopes, which is the prevailing topographic type in this region. At the top we have a vertical cliff of 10, 20, or perhaps 100 feet; then a short slope of broken rock and débris, and another little cliff; and so on to the bottom. Through the action of frost and

storm sections are split off from the faces of the vertical cliffs and the débris is scattered over the slopes.

Hence it comes about that everywhere throughout the plateau province there is an immense amount of building material ready to hand and of the proper size. In fact most of it requires no dressing or other preparation, and the only labor necessary is the selection of the material and its transportation to the place where it is to be used. The lamination of the rock causes it to split up into thin slabs or tablets, in some cases almost as regular in size as manufactured brick. With the adobe soil found everywhere throughout the country an excellent mortar is made merely by the addition of water.

The use of outlying farming settlements prevailed throughout the entire pueblo country, and as suitable building material is abundant everywhere in that region thousands of such settlements were established. In fact, wherever there was an area of cultivable land adjacent or convenient to some large village a temporary settlement would be established. Often it came about that in the course of time the temporary settlement would be regarded as more convenient or more desirable in some way than the old home, some of the people would remain there all the year around, a kiva or two would be built for their ceremonial observances, and eventually the temporary settlement would become the permanent village. Soon it would put out other settlements, which might in the course of time supplant their parent. The process was a continuous one; it arose from the scanty distribution of small areas of cultivable land here and there, and it was made possible and easy of execution by the great abundance of suitable building material derived from the mesas, which might be regarded as great manufacturing plants continuously engaged in turning out broken stone of the proper size and shape for use by the pueblo builders.

Here then we have the conditions under which pueblo architecture developed: first, an abundance of suitable building material evenly distributed over a wide area, and second, peculiar topographic conditions which rendered easy if they did not compel the frequent use of the material. There was besides an element in the social life of the people which worked through these conditions and aided them as it were in bringing about the final result. This was the defensive motive, the pressure of surrounding wild tribes, which exerted an intermittent although on the whole constant influence.

Several attempts have been made to classify the ruins of the southwest, but in none of them has sufficient regard been had to



the character of the site occupied. The ancient pueblo builder, like his modern descendant, was so completely under the dominating influence of his geographic environment that from similar conditions he almost automatically worked out similar results. In the matter of a site for his home, however, he had some latitude, and the choice he made reflected something of the social conditions under which he lived. Thus it is probable that in the earliest times the people lived in small villages located on the edges of valleys or near the mouths of fertile flat-bottomed canyons. They lived a quiet, peaceful existence, depending principally on the soil for the means of subsistence, but not despising the harvest of grass seeds and wild nuts which were at hand, and glad to break the even, placid course of existence by periodical hunting expeditions to the neighboring mountains for deer and out into the great plains for buffalo.

In the course of time, however, other and more savage tribes came to the region, and these preyed upon the prior occupants of the country, who were industrious and provident and accumulated stores against possible bad seasons. It is doubtful whether there were any pitched battles or prolonged sieges, but the robbers made periodical forays through the fields when the crops were ready for the harvest, or perhaps assaulted and looted some small village when the men were away.

Under the influence of these conditions, which were annoying rather than dangerous, the little settlements in the valleys gradually drew together, and at a still later period villages of some size were established on the foothills of mesas and slightly elevated points overlooking the fields under cultivation, for horticulture was then as always the main reliance of the people and the fields must be under constant watch and supervision when the crops were maturing. It was probably at this stage in development that the use of outlying settlements, not unknown before, but not then well established, received its first principal impetus. For the clustering of the houses into large groups and the character of the country, which provided only small areas of good land here and there, were not in accord, and some means had to be devised to meet both conditions.

The first hostile tribes to make their influence felt were doubtless the Apaches or some tribe of that stock. Later the Comanches extended their range into this region, and the Utes came down on occasional expeditions from the north. The Pueblos were more and more subjected to the pressure of these hostile tribes, who found in the villages convenient storehouses of food, and were gradually compelled to select better and more defensible sites for their villages.

But still they attempted to preserve their individuality, and it was at this stage that many of the villages occupying points of high mesas or the summits of knolls or even of great rocks or boulders were built. Eventually, however, reliance upon the site occupied was found to be inadequate, and a number of related villages combined to form a single large one. Dependence was now had on the size and population of the pueblo, and it was located again in the open valley, in the midst of and overlooking the arable lands. Such are the modern pueblos of Zuñi and Taos, or the ancient villages on the Chaco now in ruins.

Examples of villages in the various stages sketched can be found to-day. At the time of the Spanish conquest in 1540 Zuñi did not exist as one pueblo, but there were five or six villages located on foothills or low elevations and as much as fifteen miles apart. At that time the Moki Indians also occupied a number of sites on the foothills of the mesas, while perhaps one village was on top. At a comparatively recent period the Mokis moved all their villages to the mesa summits. The Zuñis soon after 1680 occupied for a short time a high mesa site, but about two centuries ago they combined all the villages into one and located it in the open valley of the Zuñi River where they are now. Similarly some of the villages, like the pueblo of Acoma, which was unsuccessfully stormed by the Spaniards in 1540, occupied high and easily defended sites three or four centuries ago, while some of the villages of that period occupied open valley sites. As a whole, however, pueblo architecture appears to have developed in the manner sketched above, and the evidence suggests such a sequence in culture, although as yet we cannot establish any chronologic order.

Under long-continued peace the great valley pueblos break up again into small settlements, through the use of outlying farming shelters, which increase in number and importance as the home village grows larger. This process is now going on in Zuñi and in Moki. It appears to complete a cycle of development through which pueblo architecture moves, bringing it finally back to where it began. There is evidence in the ruins of at least one such cycle and a suggestion that there were two. There can never be another, for the conditions have been materially modified by contact with a superior civilization, and the savage has already lost that close touch with nature through which he responded so readily to natural conditions. In the western part of the pueblo country this change has been accomplished within less than two decades past.

The outlying farming shelters, or houses occupied temporarily,

are an invariable accompaniment of pueblo life wherever and in whatever stage of development we find it. They are a distinctive and characteristic product of the country. They occur in many forms, but in function they are always the same, and their remains constitute perhaps ninety per cent. of the ruins found in the southwest, while more than ninety per cent. of the remainder are indirectly due to the use of such structures; that is, to the slow migration alluded to, which operated through this custom of establishing outlying temporary homes. In the ancient province of Tusayan, now the home of the Moki Indians, farming shelters are mere brush structures obliterated by each winter's storms; in the old province of Cibola, the modern Zuñi, they usually consist of one or two rooms in some old ruin, which are maintained in good order, while the remainder of the ruin is allowed to sink to decay. About Zuñi, however, the location is a very favorable one; the village stands principally on the north bank of the Zuñi River, whose broad and open valley provides an abundance of excellent arable land; conditions which are duplicated on a lesser scale by its tributaries. Consequently, here the individual shelters of one or two rooms are not abundant, although they occur. They are replaced by aggregations of such shelters into small villages, occupied only during the farming season, but, except for such temporary occupancy and the absence of kivas, in all respects resembling the home village. There are three of such summer establishments connected with Zuñi to-day; there is one peopled from Oraibi, the largest of the Moki villages, although located nearly seventy-five miles distant from it; and, in fact, wherever the conditions were favorable—that is, wherever large areas of cultivable land were found—the tendency of the pueblo builders to put up their houses in clusters became in evidence. In other words, it was simply a matter of geographic environment; and the rules which governed the ancient settlements are working to-day on the same lines and with much the same effects.

This influence extended still further and even determined, unconsciously to the builders, the very form as well as the size and location of house clusters. All along the valley of the Verde River in southern Arizona the farming shelters took the form of small clusters or single rooms, constructed of selected river boulders, always more or less rounded as such boulders are. Even in that circumscribed region there are hundreds and hundreds of sites of such rooms, overlooking practically every foot of desirable land

along the river. But there are village ruins also, the home establishments, as it were, never constructed of boulders, but always of tabular stone, either sandstone or limestone.

The valley of the Verde is narrow and tortuous, hemmed in by mountain ranges on either side, and the cultivable lands are comprised wholly in little benches and terraces of alluvium in crooks and elbows of the river. These are small in extent and not overabundant, but at a few places along the river they broaden out into areas of considerable size, and in such places the number of ruins increases in proportion, and clusters of rooms or whole villages are found instead of single houses.

Yet where the topographic conditions are against this form of structure and favor others, others are constructed. In certain parts of the valley of the Verde there are extensive groups of cavate lodges—chambers excavated in the cliffs and generally without masonry additions or constructions of any kind. These are, however, unquestionable farming shelters or outlooks, located with reference to some area of good land which they command, and due to the occurrence in certain places of cliffs or hills of soft volcanic ash or tufa, in which a room or rooms could be excavated with more ease and less trouble than rooms of equal size could be constructed of masonry. The remains of similar rooms or cavate lodges are found in the San Francisco mountains, on the lower San Juan, and on the Rio Grande near Santa Clara; but in each case they occur in a similar formation—a compacted volcanic ash or very soft material which can be readily scraped off with a piece of soft wood. In other words, the occurrence and location of these cavate lodges are directly due to the accident of a certain formation, to a geological peculiarity of the country.

The cliff ruins and the cavate lodges are functional counterparts of each other, and the difference in form is due merely to difference in topographic environment. A systematic study of the cliff ruins of Canyon de Chelly conducted by the writer recently, an elaborately illustrated report on which is now in press and will probably be issued before the end of the present year, makes this very clear. A detailed study of the more than 150 ruins which compose the group shows that the home villages were generally located on the canyon bottom, on wholly unprotected sites, while the cliff ruins proper, which occupied to them much the same relation that the brush shelters of Moki do to the home villages of that province, were located in coves and on benches of the cliff with

reference principally to areas of cultivable lands which they commanded. If the defensive motive entered into the selection of the site, it occupied a subordinate place.

So that we have in the southwest an elaborate system of architecture, the highest attained by the aborigines in the limits of our country, springing directly from and influenced in its minute details by a peculiar topography. Only an outline is given here of the manner of evolution of this art in house building and of its dependence on the natural conditions under which it grew and developed, but the same pronounced influence is manifested in all the details of construction and finish. It was through the modification of the parts that the whole was affected and the final result attained.

COSMOS MINDELEFF.